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1

## EXERCISE METHODS AND APPARATUS CROSS-REFERENCE TO RELATED APPLICATIONS

This application discloses subject matter entitled to the earlier filing date of U.S. Provisional Application Ser. No. 60/044,026, filed on May 5, 1997.

### FIELD OF THE INVENTION

The present invention relates to exercise methods and apparatus and more particularly, to exercise equipment which facilitates exercise through a curved path of motion.

### BACKGROUND OF THE INVENTION

Exercise equipment has been designed to facilitate a variety of exercise motions. For example, treadmills allow a person to walk or run in place; stepper machines allow a person to climb in place; bicycle machines allow a person to pedal in place; and other machines allow a person to skate and/or stride in place. Yet another type of exercise equipment has been designed to facilitate relatively more complicated exercise motions and/or to better simulate real life activity. Such equipment typically uses some sort of linkage assembly to convert a relatively simple motion, such as circular, into a relatively more complex motion, such as elliptical. One example of such equipment may be found in U.S. Pat. No. 3,316,898 to Brown. Subsequent advances in the art have facilitated additional foot motions and/or added upper body exercise, but room remains for additional improvements to machines of this type.

### SUMMARY OF THE INVENTION

The present invention may be seen to provide a novel linkage assembly and corresponding exercise apparatus suitable for linking circular motion to relatively more complex, generally elliptical motion. In at least one embodiment, a first end of a foot supporting member is rotatably connected to a crank, and a second, opposite end of the foot supporting member is supported by a roller which is selectively movable in a radial direction. The arrangement is such that rotation of the crank is linked to generally elliptical motion of an intermediate portion of the foot supporting member, and the motion is variable in response to radial movement of the roller.

In another respect, the present invention may be seen to provide a novel linkage assembly and corresponding exercise apparatus suitable for linking reciprocal motion to relatively more complex, generally elliptical motion. In at least one embodiment, the forward end of the foot supporting member is connected to a lower end of a rocker link having an upper end which is sized and configured for grasping. The arrangement is such that generally elliptical motion of the intermediate portion of the foot supporting member is linked to pivoting of the rocker link.

In yet another respect, the present invention may be seen to provide a novel linkage assembly and corresponding exercise apparatus suitable for adjusting the angle of the generally elliptical path of motion relative to a horizontal surface on which the apparatus rests. In at least one embodiment, the roller is movable up and down relative to the crank axis to change the inclination of the generally elliptical path of motion. Many of the advantages of the present invention may become more apparent from the detailed description that follows.

### BRIEF DESCRIPTION OF THE DRAWING

With reference to the Figures of the Drawing, wherein like numerals represent like parts and assemblies throughout the several views,

2

FIG. 1 is a side view of a first exercise apparatus constructed according to the principles of the present invention;

FIG. 2 is a side view of a second exercise apparatus constructed according to the principles of the present invention;

FIG. 3 is a side view of a third exercise apparatus constructed according to the principles of the present invention;

FIG. 4 is a side view of a fourth exercise apparatus constructed according to the principles of the present invention; and

FIG. 5 is a side view of a fifth exercise apparatus constructed according to the principles of the present invention.

### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Several embodiments of the present invention are described below with reference to the accompanying drawings. On each embodiment, a linkage assembly moves relative to a frame in a manner that links rotation of a crank to generally elliptical motion of a foot supporting member. The term "elliptical motion" is intended in a broad sense to describe a closed path of motion having a relatively longer first axis and a relatively shorter second axis (which extends perpendicular to the first axis).

Each frame includes a base which may be described as generally I-shaped and designed to rest upon a generally horizontal floor surface. Each apparatus is generally symmetrical about a vertical plane extending lengthwise through the base (perpendicular to the transverse members at each end thereof), the only exception being the relative orientation of linkage assembly components on opposite sides of the plane of symmetry. In general, the "right-hand" components are one hundred and eighty degrees out of phase relative to the "left-hand" components. However, like reference numerals are used to designate both the "right-hand" and "left-hand" parts, and when reference is made to one or more parts on only one side of an apparatus, it is to be understood that corresponding part(s) are disposed on the opposite side of the apparatus. Also, the portions of the frame which are intersected by the plane of symmetry exist individually and thus, do not have any "opposite side" counterparts. Moreover, to the extent that reference is made to forward or rearward portions, it is to be understood that a person could exercise while facing in either direction relative to the linkage assembly.

A first exercise apparatus constructed according to the principles of the present invention is designated as 100 in FIG. 1. The apparatus has a frame 110 which includes an I-shaped base 112; a forward stanchion or upright 115 which extends upward from the base 112 proximate a first end 113 thereof; and a rearward stanchion or upright 116 which extends upward from the base 112 proximate a second, opposite end 114 thereof.

Left and right flywheels 120 are rotatably mounted on opposite sides of the rearward stanchion 116 and rotate together about a common crank axis 126. Those skilled in the art will recognize that the flywheels 120 may be connected to a conventional resistance device or replaced by some other rotating member(s) which may or may not, in turn, be connected to one or more flywheels and/or a conventional resistance device.

Left and right foot supporting members 140 have rear ends which are rotatably connected to radially displaced

portions of respective cranks 120, thereby defining rotational axes 142. The rotational axes 142 are constrained to rotate about the crank axis 126 and thereby define fixed crank radii.

An intermediate portion of each foot supporting member 140 is sized and configured to support a respective foot of a standing person. A forward end of each foot supporting member 140 is supported by a respective roller 150 which rotates relative to the frame 110. More specifically, an adjustable length member 155 is rigidly mounted on the forward stanchion 115, and the rollers 150 are rotatably mounted on a selectively movable portion of the adjustable length member 155. When the roller 150 occupies the position shown in solid lines in FIG. 1, rotation of the crank 120 is linked to movement of a person's feet move through the generally elliptical path designated as P.

A user accessible device 160 is mounted on top of the forward stanchion 115 to provide information regarding and/or facilitate adjustment of exercise parameters. For example, a button 165 may be depressed to change the length of the adjustable length member 155 and thereby reposition the rollers 150 relative to the crank axis 126. As suggested by the roller 150' and path P' shown in dashed lines in FIG. 1, relatively higher rollers results in a relatively more "uphill" exercise.

A second exercise apparatus constructed according to the principles of the present invention is designated as 200 in FIG. 2. The apparatus has a frame 210 which includes an I-shaped base 212; a forward stanchion or upright 215 which extends upward from the base 212 proximate a first end 213 thereof; and a rearward stanchion or upright 216 which extends upward from the base 212 proximate a second, opposite end 214 thereof.

Left and right flywheels 220 are rotatably mounted on opposite sides of the rearward stanchion 216 and rotate together about a common crank axis 226. Those skilled in the art will recognize that the flywheels 220 may be connected to a conventional resistance device or replaced by some other rotating member(s) which may or may not, in turn, be connected to one or more flywheels and/or a conventional resistance device.

Left and right foot supporting members 240 have rear ends which are rotatably connected to radially displaced portions of respective cranks 220, thereby defining rotational axes 242. The rotational axes 242 are constrained to rotate about the crank axis 226 and thereby define fixed crank radii.

An intermediate portion of each foot supporting member 240 is sized and configured to support a respective foot of a standing person. A forward end of each foot supporting member 240 is supported by a respective roller 250 which rotates relative to the frame 210. Each roller 250 is a circular gear 250 having a geometric center 251 and gear teeth disposed about its circumference, and an eccentric portion of each roller 250 is rotatably mounted to the forward stanchion 215, thereby defining rotational axes 255. Mating rack gear teeth extend downward from the forward end of each foot supporting member 240 and engage the teeth on a respective gear 250. The gear teeth prevent slippage of either foot supporting member relative to a respective roller 250. The resulting foot path is designated as P2 in FIG. 2. Inclination adjustment may be added as a matter of design choice.

A third exercise apparatus constructed according to the principles of the present invention is designated as 300 in FIG. 3. The apparatus has a frame 310 which includes an

I-shaped base 312; a forward stanchion or upright 315 which extends upward from the base 312 proximate a first end 313 thereof; and a rearward stanchion or upright 316 which extends upward from the base 312 proximate a second, opposite end 314 thereof.

Left and right flywheels 320 are rotatably mounted on opposite sides of the rearward stanchion 316 and rotate together about a common crank axis 326. Those skilled in the art will recognize that the flywheels 320 may be connected to a conventional resistance device or replaced by some other rotating member(s) which may or may not, in turn, be connected to one or more flywheels and/or a conventional resistance device.

Left and right foot supporting members 340 have rear ends which are rotatably connected to radially displaced portions of respective cranks 320, thereby defining rotational axes 342. The rotational axes 342 are constrained to rotate about the crank axis 326 and thereby define fixed crank radii.

An intermediate portion of each foot supporting member 340 is sized and configured to support a respective foot of a standing person. A forward end of each foot supporting member 340 is supported by a respective roller 350 which is rotatably mounted on a lower end of a respective handle bar rocker link 370. An intermediate portion of each rocker link 370 is rotatably connected to the forward stanchion 315, and an upper end of each rocker link 370 is sized and configured for grasping.

The resulting assembly facilitates several different exercise modes or routines. In a first routine, for example, a user may maintain the handle bar rocker links 370 in a vertical orientation while moving his feet through fixed elliptical paths of motions. In a second routine, for example, a user may maintain the handle bar rocker links 370 in rearwardly tilted orientations while moving his feet through fixed elliptical paths of motion which are relatively more upwardly inclined. In a third routine, for example, a user may move the handle bar rocker links 370 while moving his feet through paths of motion which vary in accordance with the motion of the rocker links 370.

The apparatus 300 may be modified in a variety of ways to facilitate additional exercise modes. For example, the rocker links 370 may be selectively pinned to the forward stanchion 315 to provide a stationary support which does not require physical exertion to remain in place. Also, the rocker links 370 may be selectively pinned in various orientations relative to the forward stanchion 315 to provide different handle orientations and inclinations of foot travel. Moreover, the rocker links 370 may be rigidly connected to one another so that they pivot together relative to the forward stanchion 315. Furthermore, the rocker links 370 may be "cross-coupled" so that they are constrained to pivot in opposite directions relative to the forward stanchion 315.

A fourth exercise apparatus constructed according to the principles of the present invention is designated as 400 in FIG. 4. The apparatus has a frame 410 which includes an I-shaped base 412; a forward stanchion or upright 415 which extends upward from the base 412 proximate a first end 413 thereof; and a rearward stanchion or upright 416 which extends upward from the base 412 proximate a second, opposite end 414 thereof.

Left and right flywheels 420 are rotatably mounted on opposite sides of the rearward stanchion 416 and rotate together about a common crank axis 426. Those skilled in the art will recognize that the flywheels 420 may be connected to a conventional resistance device or replaced by